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TWO-STAGE, THROUGH-SHAFT SCROLL COMPRESSOR
[Jiku kantsuu nidann skuroru asshuku ki]

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Claims

1. A scroll compressor in which a fixed scroll member and an orbital scroll member, wherein spiral wraps are erected on end plates, are eccentrically assembled with their wraps facing one another, and a crankshaft that is disposed passing through the orbital scroll and the fixed scroll is rotationally driven, without allowing the aforementioned orbital scroll member to freewheel, so as to compress gas, wherein said two-stage, through-shaft scroll compressor is characterized by erecting wraps on both surfaces of an end plate in the orbital scroll, and assembling a first fixed scroll wrap with the first wrap on one surface to form a first intake chamber and a first compression chamber, and assembling a second fixed scroll wrap with the second wrap on the other surface to form a second intake chamber and a second compression chamber, by providing an orbital shaft bearing penetrated by the orbital drive shaft at the center of the aforementioned orbital scroll end plate, disposing a first fixed bearing that supports one end of the aforementioned drive shaft at the center of the aforementioned first fixed scroll end plate, disposing a second fixed bearing that supports the other end of the aforementioned drive shaft at the center of the aforementioned second fixed scroll end plate, and by rotationally driving the aforementioned orbital scroll, compressing gas sucked into the first intake chamber in the first compression chamber, transferring the thus compressed gas to the second intake chamber and recompressing it in the second compression chamber.

2. The two-stage, through-shaft scroll compressor disclosed in Claim 1 or 2 [sic], wherein the minimum sealed volume of the first compression chamber is equal to the maximum sealed volume of the second compression chamber.

3. The two-stage, through-shaft scroll compressor disclosed in Claim 2, wherein the spiral shapes of the first fixed scroll wrap and the second fixed scroll wrap are plane-symmetric, and the wall height is set

so that the minimum sealed volume of the first compression chamber is equal to the maximum sealed volume of the second compression chamber.

4. The two-stage, through-shaft scroll compressor disclosed in Claim 1, wherein the pressure ratio of the first compression chamber and the pressure ratio of the second compression chamber are nearly equal.

5. The two-stage, through-shaft scroll compressor disclosed in Claim 1, wherein the spiral shapes of the first fixed scroll wrap and the second fixed scroll wrap are plane-symmetric, and the wall height ratio is equal to the ratio of the maximum sealed volume of the first compression chamber to its minimum sealed volume.

6. The two-stage, through-shaft scroll compressor disclosed in Claim 1, which is characterized by providing a first discharge port, through which gas compressed by the first compression chamber is released, in the end plate of the orbital spiral, and providing a connecting passage that connects said discharge port with the second intake chamber in the spiral scroll end plate.

7. The two-stage, through-shaft scroll compressor disclosed in Claim 1, which is characterized by providing anti-freewheeling mechanism within the range of the thickness of the orbital scroll end plates.

8. The two-stage, through-shaft scroll compressor disclosed in Claim 5, which is characterized in that it is possible to subdivide the orbital scroll in two within the range of the thickness of the end plates, and anti-wheeling mechanism parts are sandwiched between said end plates so as to be moveable within a plane.

9. The two-stage, through-shaft scroll compressor disclosed in Claim 5, which is characterized by assembling the first fixed scroll and second fixed scroll holding a cylindrical frame, whose thickness is a minute dimension greater than the thickness of the spiral scroll end plates, sandwiched between them, and providing a guide slot for an anti-freewheeling mechanism in said frame.

10. The two-stage, through-shaft scroll compressor disclosed in Claim 5, which is characterized by the anti-freewheeling mechanism having a shape in which a pair of point-symmetric keys, which fit into guide slots on the orbital scroll end plates, is disposed protruding from a circular or elliptical ring member perpendicular to at least one surface of the ring, and a pair of keys that fit into guide slots in the frame is disposed protruding in the radial direction at a position shifted 90° from said keys.

11. The two-stage, through-shaft scroll compressor disclosed in Claim 1, which is characterized by the front edges of the first wrap of the orbital scroll and the first fixed scroll wrap being flat, and a seal member being mounted on either one or both of the front edge of the second wrap of the orbital scroll and the front edge of the second fixed wrap.

12 The two-stage, through-shaft scroll compressor disclosed in Claim 1, which is characterized by providing an oil supply passage that extends from the side edge face in a crankshaft oil reservoir to the inside of the rotary shaft, providing various oil supply holes from said oil supply passage that open facing the bearing surface near the bearing end on the high-pressure air side of the first fixed bearing, on which the first fixed scroll is mounted, and the bearing surface near the bearing end on the high-pressure air side of the rotary bearing in which the orbital scroll is disposed, providing a gas passage through which discharge gas from the second compression chamber passes into the interior of a second centered shaft, and providing an oil supply hole that supplies oil that has been centrifugally released from said passage to the second fixed bearing.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains a two-stage, through-shaft scroll compressor in a scroll compressor, in which the orbital scroll is rotary driven without allowing it to freewheel, that is constituted with a crankshaft passing through an orbital scroll and a fixed scroll in order to improve the efficiency in two-stage compression.

[0002]

Prior art

A mechanism is disclosed in United States Patent No. 3600114, in which a drive shaft is passed through an orbital scroll, wraps are disposed on both sides of an end plate, and fixed scrolls are respectively assembled with each to form compression chambers, whereby both compression chambers are simultaneously used in parallel. However, this example does not show an example in which the compression chambers on either side are used in series for two-stage compression.

[0003]

A structure is disclosed in Japanese Kokai Patent Application No. Hei 5[1993]-60078, wherein wraps are disposed on both sides of an orbital scroll end plate and fixed scrolls are respectively assembled with these to form compression chambers, with the lower compression chamber comprising a first-stage compression chamber and the upper compression chamber comprising a second-stage compression chamber, but the bearing is in the bottom of the end plate and does not pass through the orbital scroll. In addition, the upper and lower scroll wraps are different shapes.

[0004]

Problems solved by the invention

There are cases wherein the efficiency of a two-stage compressor is maximized by the pressure ratio of the first-stage compressor being equal to the pressure ratio of the second-stage compressor. However, /3 since the shapes of the upper and lower wraps differed in conventional methods, the intrinsic compression ratio of the upper part differed from the intrinsic compression ratio of the lower part, so that the compressor efficiency was not maximized. In addition, since the center of the orbital scroll end plate was not penetrated, there were problems in that the discharge output of the high-pressure stage would act on its central area, increasing the load exerted on the central area of the low-pressure stage due to the pressure differential with the intake pressure, which caused the orbital scroll to press down from the high-pressure side toward the low-pressure side with intense thrust, increasing the friction loss on one surface, while causing a gap on the other surface and increasing leakage loss.

[0005]

Means to solve the problems

To solve the aforementioned problems, the two-stage, through-shaft scroll compressor of this invention is a scroll compressor in which a fixed scroll member and an orbital scroll member, wherein spiral wraps are erected on end plates, are eccentrically assembled with their wraps facing one another, and a crankshaft that is disposed passing through the orbital scroll and the fixed scroll is rotationally driven, without allowing the aforementioned orbital scroll member to freewheel, so as to compress gas, which is characterized by erecting wraps on both surfaces of an end plate in the orbital scroll, and assembling a first fixed scroll wrap with the first wrap on one surface to form a first intake chamber and a first compression chamber, and assembling a second fixed scroll wrap with the second wrap on the other surface to form a

second intake chamber and a second compression chamber, by providing an orbital shaft bearing penetrated by the orbital drive shaft at the center of the aforementioned orbital scroll end plate, disposing a first fixed bearing that supports one end of the aforementioned drive shaft at the center of the aforementioned first fixed scroll end plate, disposing a second fixed bearing that supports the other end of the aforementioned drive shaft at the center of the aforementioned second fixed scroll end plate, and by rotationally driving the aforementioned orbital scroll, compressing gas sucked into the first intake chamber in the first compression chamber, transferring the thus compressed gas to the second intake chamber and recompressing it in the second compression chamber, wherein, generally, a drive shaft is passed through the orbital scrolls, laps of different wall height are erected in symmetric spiral patterns on both sides of an end plate, the bearing surfaces of the upper compression chamber and the lower compression chamber are symmetrical, and the intrinsic compression ratios of both compression chambers are the same.

[0006]

Operation

By making the compression ratio of the first-stage compressor and the compression ratio of the second-stage compressor equal, it becomes possible to miniaturize the two-stage compressor, while simultaneously maximizing its efficiency, and by passing the drive shaft through the orbital scrolls, the thrust exerted by the high-pressure stage on the low-pressure stage is decreased.

[0007]

Example embodiments

Example embodiments of this invention will be described using Figures 1-13.

[0008]

Figure 1 is a sectional drawing that shows the overall constitution of a first example embodiment of a sealed scroll compressor of this invention. A compressor comprising a first fixed scroll 210, an orbital scroll 300 with wraps erected on both sides of an end plate, and a second fixed scroll 220, a crankshaft 500 that drives the orbital scroll 300, and an electric drive motor 700 are enclosed as a single unit inside a sealed case 100. An eccentric shaft 520 of the crank shaft 500 passes through the orbital scroll 300, the shafts on either side of it respectively pass through the end plate of the first fixed scroll 210 and the end plate of the second fixed scroll 220, and the first centered shaft 510 is respectively supported by a first fixed bearing 212 that is disposed at the center of the end plate of the first fixed scroll 210 and a second fixed bearing 222 that is disposed at the center of the end plate of the second fixed scroll 230. A bearing 721 is disposed at the top that supports the rotary shaft of a rotor 720 in the electric motor 700.

[0009]

The orbital scroll 300 is disposed between the outer perimeter of the end plate 320 on the second wrap side and the outer perimeter of the second fixed scroll; its freewheeling is restricted by an anti-freewheeling mechanism 400 that uses an Oldham ring, and it is rotationally driven through the eccentric shaft 520 by rotation of the crankshaft 500. A first balance weight 519 and a second balance weight 539 are mounted on the crankshaft 500 to cancel the centrifugal force of the orbital scroll 300 and prevent vibration. Gas is taken from an intake tube 110 into a first intake chamber 213, compressed by a first compression chamber 214 formed by the first fixed scroll 210 and the orbital scroll 300, discharged from a first discharge port 231 to a connecting passage 322 disposed inside the orbital scroll end plate, is taken into a second intake chamber 223 formed by the second fixed scroll 220 and the orbital scroll 300,

compressed by a second compression chamber 224, and discharged from a second discharge port 225 into the sealed case 100. The gas is subsequently discharged from a discharge tube 120 to the outside of the sealed case.

[0010]

The spiral shapes of the wraps 211 and 311 that form the first compression chamber are identical to those of the wraps 221 and 312 that form the second compression chamber so that the minimum sealed volume immediately before one of the compression chambers of the multiplicity of first compression chambers 214 in the low-pressure stage opens to the first discharge port 321 is nearly equal to the maximum sealed volume when the second compression chamber 224 in the high-pressure stage begins compression, the ratio of the wall heights is set so that it is nearly equal to the ratio of the aforementioned minimum sealed volume to the maximum sealed volume, and a passage 322 is provided connecting both chambers and the intrinsic compression ratio of the upper portion is equal to the intrinsic compression ratio of the lower portion.

[0011]

An example of a two-stage compression refrigeration cycle is shown in Figure 2. A compressor 1000 comprises a first-stage compressor 1010 and a second-stage compressor 1020. Gas taken in from a first-stage intake 1 takes on extra gas from an intermediate intake 1800, and is discharged from a second-stage discharge 4. The discharge gas passes through a 4-way valve 1100, is passed through an indoor heat exchanger 1200 and condensed, then decompressed by a first expansion valve 1300, the mainstream coolant is then further decompressed by a second expansion valve 1500 and it evaporates via

an outdoor heat exchanger 1600, and then passes through the 4-way valve 1100, where it is taken up again by the compressor from the intake 1. A branch 6 diverts some of the coolant, where it is decompressed /4
by a third expansion valve 1700 and reaches the intermediate intake 1800. During this time, heat exchange between the mainstream coolant and the diverted coolant is affected by a coolant heat exchanger 1400, cooling and liquefying the mainstream coolant and heating the diverted coolant, to make a partially evaporated, two-phase flow.

[0012]

A Mollier diagram representing these state changes is shown in Figure 3. The horizontal axis is enthalpy per unit mass and the vertical axis is pressure. Gas taken in from the first-stage intake 1 is compressed by the first-stage compressor, intermediate-pressure, two-phase-flow coolant is taken in between the first-stage discharge 2 and the second-stage intake 3, momentarily decreasing enthalpy, and is then compressed again by the second-stage compressor and discharged from the second-stage discharge 4 to the cycle. The states in the cycle are shown by the same numerals corresponding to positions 5-10 in Figure 2. Less work is required of the compressor in this cycle than when compressing from the pressure at 1 to the pressure at 4 in a single stage, and efficiency is improved. Efficiency is maximized when the pressure ratio from 1 to 2 is equal to the pressure ratio from 3 to 4, and efficiency is maximized by making the pressure ratio in the aforementioned first compression chamber roughly equal to the pressure ratio of the second compression chamber.

[0013]

Since a first-stage and a second-stage compression chamber are formed on either surface of a single orbital scroll 300 according to the first example embodiment, a small, lightweight two-stage compressor

with a small diameter can be realized that maximizes efficiency by making the pressure ratio of the first compression chamber roughly equal to the pressure ratio of the second pressure chamber. In addition, since a connecting passage 322 between the first stage and second stage is disposed inside the orbital scroll end plate 320, tubing is unnecessary for connection and the structure is simplified. In addition, by passing an eccentric shaft 520 through the center of the scroll compressor, roughly equal pressure is exerted on the upper and lower end faces of the shaft, excessive thrust is not exerted on the scroll. Therefore, the problems discussed in the preceding problems section, i.e., the problem of the discharge pressure of the high-pressure-stage being exerted on the center area, increasing the load resulting from the pressure differential between this pressure and the intake pressure exerted in the center area of the low-pressure stage, thus causing the orbital scroll to be pressed down by the intense thrust from the high-pressure-stage toward the low-pressure-stage, increasing the friction loss on one surface and increasing the leakage loss caused by the gap formed on the other surface. In the aforementioned first example embodiment, since efficiency is maximized by making the pressure ratio of the first compression chamber roughly equal to the pressure ratio of the second compression chamber, and nearly equal pressure is exerted on the upper and lower end faces of the shaft by passing an eccentric shaft through the center of the scroll compressor, excessive thrust is not exerted on the scroll, and the same is true for the various example embodiments below.

[0014]

Figures 4-7 are drawings illustrating a second example embodiment of this invention. Figure 4 shows an overall sectional drawing. Figure 5 is a sectional drawing of a horizontal section of the compressor viewed at 90° from the point of view in Figure 4. Figure 6 shows an example of an Oldham ring 400 that constitutes an anti-freewheeling mechanism used in this example embodiment. Figure 7 shows an

example of an orbital scroll, bearings, and frame used in this example embodiment. The end plate 320 of the orbital scroll has a split structure comprising a first end plate 320a with a first wrap 311 and a second end plate 320b with a second wrap 312. An Oldham ring 400 is sandwiched between the first end plate 320a and second end plate 320b, maintaining a minute gap, and a spacer 340 is fixed in the gap. In the Oldham ring 400, an orbital-side key 401 and frame-side key 402 are disposed on a circular or nearly circular annular chassis. At this time, the orbital-side key 401 on the Oldham ring 400 is inserted into a key slot 323 disposed on the end plate. The Oldham ring 400 can be moved in the direction of the key slot 323 between the first end plate 320a and the second end plate 320b.

[0015]

The unit comprising the orbital scroll 300, Oldham ring 400, and frame 600 is constituted so that the frame-side key 402 is fitted into a key slot 601 on the frame, and is sandwiched between the first fixed scroll 210 and the second fixed scroll, and the two aforementioned fixed scrolls are fastened to the frame 600, as shown in Figures 4 and 5. The first fixed scroll and second fixed scroll are assembled sandwiching the cylindrical frame, which is minutely thicker than the thickness of the orbital scroll end plate, between them. The space between the first end plate 320a and second end plate 320b is also used as a connecting passage 322 that connects the first discharge port 321 and second intake chamber 223. A first balance weight 519 is disposed on the first centered shaft 510 and a second balance weight 539 is disposed on the second centered shaft 530.

[0016]

According to the second example embodiment, since the anti-freewheeling mechanism 400 is built into the end plate 320 of the orbital scroll 300, mechanisms unrelated to compression do not have be assembled

on the wrap surfaces, making further miniaturization possible. In addition, since loads exerted on the Oldham ring 400 are perfectly symmetrical, there are no forces generated that would tip the ring. Additionally, disposing balance weights 519, 539 on both sides of the orbital scroll facilitates operation with stable behavior, which increases reliability and decreases vibration and noise.

[0017]

A third example embodiment of this invention is shown in Figure 8. In this example embodiment, the discharge path is changed and oil supply passages to the bearings are disclosed. An oil supply passage 511 is disposed from the first centered shaft 510 to the eccentric shaft 520. From this oil supply passage, an oil supply hole 512 is provided toward the first fixed bearing 212, and an oil supply hole 522 is provided toward the orbital shaft bearing 330.

[0018]

The inside of the compressor case 1 is at discharge pressure, and the oil pressure inside the oil reservoir is also at discharge pressure. Since the central chamber pressure of the first compression chamber is an intermediate pressure that is lower than the discharge pressure, oil is passed through the oil supply passage 511 and oil supply holes 512 522 by the pressure differential, respectively supplying oil to the first fixed bearing 212 and orbital shaft bearing 330. The route of gas from the first compression chamber to the second compression chamber is the same as in the second example embodiment. A discharge passage 533 connecting to the second discharge port is disposed inside the second centered shaft 530, and gas that has been compressed by the second compression chamber 224 is guided through said passage to the upper portion inside the sealed case 100, and is discharged from a discharge tube 120. At this time, oil /5

contained in the discharge gas is centrifugally separated by a trap 534 and supplied to the second fixed bearing 222 from an oil supply hole 532. A bearing 721 is mounted at the upper end of the shaft that supports the rotary shaft of the rotor 720 of the electric motor 700 and allows it to spin, and is lubricated by the oil mist contained in the discharge gas.

[0019]

According to the third example embodiment, since an oil supply pressure differential toward the first fixed scroll bearing 212 is constantly produced, even if there are large fluctuations in the intake pressure and discharge pressure, and oil supplied to the first fixed bearing 212 and orbital shaft bearing 333 are confluent and passes through a trap 534, thus reliability is high because oil is centrifugally supplied without drying up and regardless of the pressure conditions.

[0020]

A fourth example embodiment of this invention is shown in Figure 9. In this example embodiment, a compressor comprising fixed scrolls 210 and 220 and an orbital scroll 300 is disposed at the top and a motor 700 is disposed at the bottom. A rotor 720 is mounted on a first centered shaft 510. An oil guide tube 540 is mounted on the bottom end of the shaft. An oil supply passage 511 is disposed running from the first centered shaft 510 to the orbital shaft 520. Oil supply holes 512 and 522 are respectively disposed from said oil supply passage toward the first fixed bearing 212 and the orbital shaft bearing 330. Since the interior of the sealed case 100 is at discharge pressure, and the upper end of the first fixed bearing and the lower end of the orbital shaft bearing 330 are connected to the central chamber of the first compression chamber 214 and are at intermediate pressure, oil 800 is supplied to the various bearings by the pressure differential. A rotor bearing 721 is installed that supports the rotary shaft of the rotor 710 of the electric

motor 700, and an oil supply hole 513 is provided toward said bearing, whereby oil supplied by centrifugal force. The oil supply passages and gas passage from the first compression chamber to the second compression chamber are similar to those in the second example embodiment. A discharge passage 533 connecting to the second discharge port is disposed inside the second centered shaft 530, and gas compressed by the second compression chamber 224 is guided to the top of the sealed case interior through said passage, where it is discharged from a discharge tube 120. At this time, oil contained in the discharge gas is centrifugally separated along the way, and then supplied from the oil supply hole 532 to the second fixed bearing 222.

[0021]

Since oil can be forcibly supplied even to the second fixed bearing 22 at the very top in the fourth example embodiment, all the bearings can be constituted with smooth bearing action. In addition, since the compressors are at the top, even in cases where the liquid coolant lays dormant inside the sealed case 100, there is little risk that the liquid coolant will lay dormant inside the compression chambers.

[0022]

A fifth example embodiment of this invention is shown in Figure 10. The points of difference between this example embodiment and the fourth example embodiment are that the orbital scrolls are left separated as 300a and 300b and mounted on a common orbital shaft 520 and thereby positioned at the center. As shown in Figure 11, while there is no reference hole on the orbital scroll end plate 320a for alignment with its companion fixed scroll, a projecting ring 350 is formed on end plate 320b as a spacer. Consequently, alignment of the orbital scrolls in the diameter direction is performed by the respective positional

relationships between the bearings and the concentric shaft. In addition, alignment in the rotary direction is performed by the positional relationship between the Oldham key 410 and the key slot 323.

[0023]

According to the fifth example embodiment, since the Oldham ring 400 is already incorporated during assembly of all the individual parts once it has been sandwiched between the orbital scroll end plates 320a and 320b, there is no need for an additional process and fabrication, whereby the fabrication and assembly are simplified.

[0024]

A sixth example embodiment of this invention is shown in Figure 12. The scroll structure is similar to that in the fourth example embodiment shown in Figure 9. When the axial gas pressure on the side of the first compression chamber 214 of the orbital scroll 300 is compared to the axial gas pressure on the side of the second compression chamber 224, the pressure is higher on the side of the second compression chamber, generating substantial axial gas pressure. Consequently, the orbital scroll 300 is pressed toward the first compression chamber 214, forcing the edge of the first fixed scroll wrap 211 and the edge of the first wrap 311 of the orbital scroll 300 tightly against the wall bottoms of their companion scrolls and reducing the gaps to 0, while creating a slight gap between the edge of the second fixed scroll wrap 312 and the edge of the second wrap 221 of the orbital scroll 300. In this example embodiment, a tape seal 900 is installed on the edge of the second wrap 221 of the orbital scroll 300 to prevent leakage in this area. Of course, the leak-preventing effect would be increased if tape seal were also installed on the edge of the second fixed scroll wrap 221.

[0025]

Since leakage in the second compression chamber can be minimized according to the sixth example embodiment, compressor efficiency can be even further increased.

[0026]

A seventh example embodiment of this invention is shown in Figure 13. A compressor unit comprising a first fixed scroll 210, a second fixed scroll 220, and an orbital scroll 300, etc. is disposed in the upper portion, and an electric motor 700 is disposed in the lower portion inside a sealed case under an intake pressure atmosphere. The top of the second fixed scroll is covered with a discharge cover 230, whose interior constitutes a discharge chamber 231, which is connected to the outside of the sealed case by a discharge tube 230. An intake tube 110 is opened in the sealed case 100, and guides intake gas into the sealed case. Thereafter, it is introduced to a first intake chamber 213 and compressed by a first compression chamber 214, after which, it is introduced to a second intake chamber via a first discharge port 321 and connecting passage 322, compressed by a second compression chamber 224, and then discharged from a second discharge port 225 to the discharge chamber 231, and discharge outside the compressor from a discharge tube 120 [*sic.*]. An oil pump 810 is mounted at the bottom end of a crankshaft 500, whereby oil 800 is supplied to the various bearings via an oil introduction tube 540 and oil supply passage 511 inside the shaft.

[0027]

Since the interior of the sealed case 100 is an intake pressure atmosphere according to the sixth example embodiment, the case wall thickness can be made thinner, making the unit more lightweight. In

addition, since the electric motor 700 is in a low-temperature atmosphere, the winding temperatures are decreased, reliability is decreased, and copper loss is decreased, making it possible to use the electric motor in a high-efficiency state. /6

[0028]

Effect of the invention

Because a crankshaft is passed through an orbital scroll, spirals on either side of an end plate are symmetrical and erected at different wall heights, the bearing surfaces of the upper compression chamber and lower compression chamber are symmetrical, and the intrinsic compression ratios of both compression chambers are identical, according to this invention, the load differential exerted on the orbital scroll end plate can be minimized, and by making the first-stage compression ratio the same as the second-stage compression ratio and making respective pressure ratios identical, the two-stage compressor can be made smaller and its efficiency can be maximized.

<u>Brief description of the figures</u>

Figure 1, overall structural sectional drawing of a sealed scroll compressor of this invention

Figure 2, drawing showing and example of a two-stage cooling cycle in this invention

Figure 3, mollier diagram of said cooling cycle

Figure 4, overall structural sectional drawing of the compressor in a second example embodiment of this invention

Figure 5, partial sectional drawing viewed from the direction perpendicular to Figure 4

Figure 6, structural drawing for an Oldham ring in a second example embodiment of this invention

Figure 7, orbital scroll assembly drawing in a second example embodiment of this invention

Figure 8, overall structural sectional drawing of a third example embodiment of this invention

Figure 9, overall structural sectional drawing of a fourth example embodiment of this invention

Figure 10, overall structural sectional drawing of a fifth example embodiment of this invention

Figure 11, orbital scroll assembly drawing in a fifth example embodiment of this invention

Figure 12, orbital scroll assembly drawing in a sixth example embodiment of this invention

Figure 13, overall structural sectional drawing of a seventh example embodiment of this invention

Explanation of symbols

100	Sealed case
110	Intake tube
120	Discharge tube
130	Injection tube
131	Injection port
210	First fixed scroll
211	First fixed scroll wrap
212	First fixed bearing
213	First intake chamber
214	First compression chamber
220	Second fixed scroll
221	Second fixed scroll wrap
222	Second fixed bearing
223	Second intake chamber
224	Second compression chamber

225 Second discharge hole

300 Orbital scroll

311 Orbital scroll first wrap

312 Orbital scroll second wrap

320 End plate

321 First discharge hole

322 Connecting passage

323 Key slot

330 Rotary shaft bearing

340 Pin

341 Hole

350 Projecting ring

400 Oldham ring

410 Oldham key

500 Crankshaft

510 First centered shaft

511 Oil supply passage

512 Oil supply hole

519 First balance weight

520 Eccentric shaft

521 Oil supply passage

522 Oil supply hole

530 Second centered shaft

531	Oil supply passage
532	Oil supply hole
533	Discharge passage
539	Second balance weight
540	Oil intake tube
600	Frame
700	Electric motor
710	Stator
720	Rotor
800	Oil
900	Tip seal
1000	Compressor
1010	Low-stage side compressor
1020	High-stage side compressor
1100	4-way valve
1200	Indoor heat exchanger
1300	First expansion valve
1400	Coolant heat exchanger
1500	Second expansion valve
1600	Outdoor heat exchanger
1700	Third expansion valve
1800	Intermediate intake

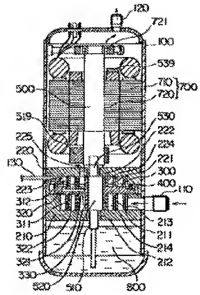

Figure 1

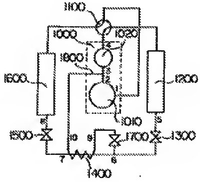

Figure 2

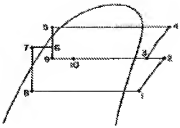

Figure 3

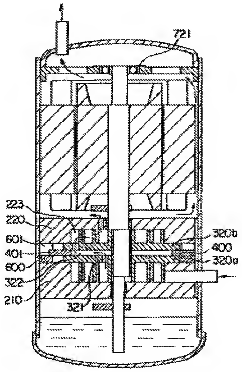

Figure 4

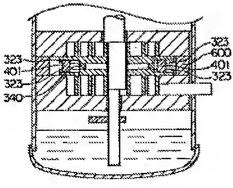

Figure 5

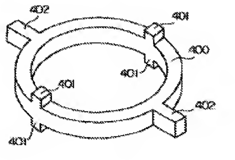

Figure 6

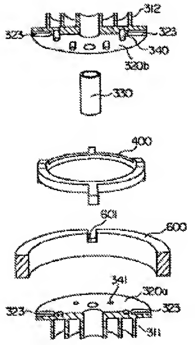

Figure 7

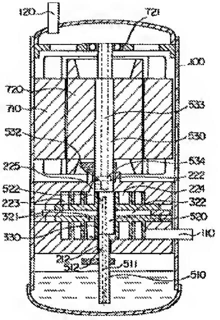

Figure 8

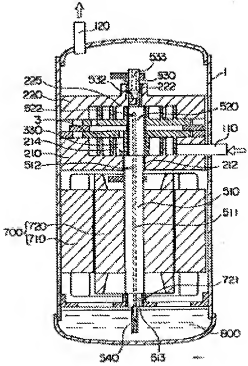

Figure 9

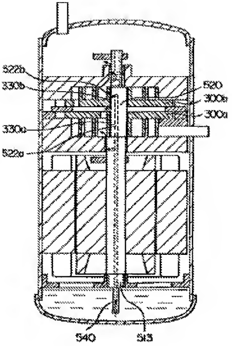

Figure 10

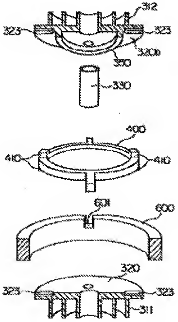

Figure 11

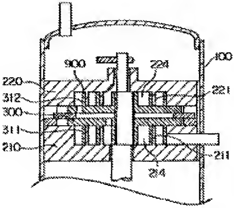

Figure 12

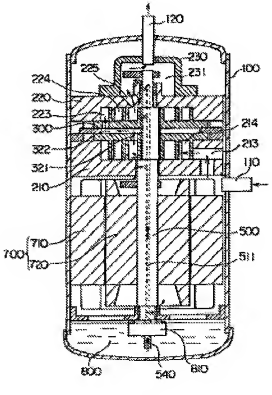

Figure 13